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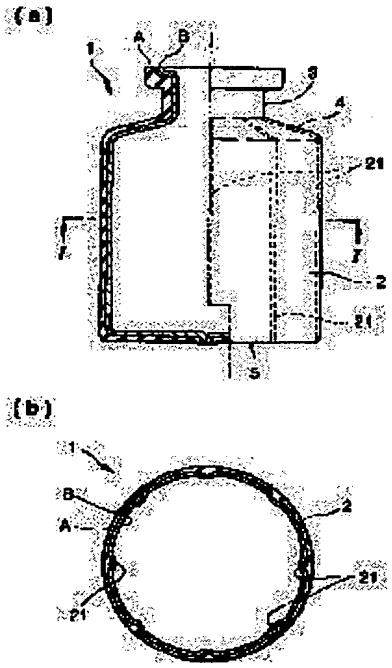
(71)Applicant : HANSHIN KASEI KOGYO KK
(72)Inventor : YOSHIOKA TSUNEMI
MORIZAKI HIROSHI

(54) MULTILAYER THIN WALL CONTAINER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a multilayer thin wall container which has a cylindrical part and a neck part for fitting a cap and also has sufficient liquid draining and volume reducing properties and further can be manufactured by a simpler process.
SOLUTION: This multilayer thin wall container 1 is a thin wall container of a multilayer structure monolithically molded by extrusion blow molding of a parison, including an outside layer A of a highly rigid resin and an inside layer B of a low rigid resin. When the parison is extrusion-molded the rigidity of the neck part 3 is set to be higher than the rigidity of a a cylindrical part 2 by increasing the extrusion amount of the highly rigid resin to a part corresponding to the neck part 3. Besides when the parison is extrusion-molded, it is extruded by a sectional shape with plural protrusions arranged in the peripheral direction. Thus plural ribs 21 of the highly rigid resin are formed on the cylindrical part 2 along axial lines.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is the thin walled vessel of the multilayer structure which was equipped with a drum section and the opening neck for cap wearing, and was really fabricated by the extrusion blow molding of parison. The outside layer and elastic modulus of high rigidity resin whose elastic modulus is 1500-18000kg/cm2 contain the inside layer of low rigidity resin 1000kg/cm2 or less. The amount of extrusion of the high rigidity resin to the part equivalent to said opening neck and by facing and increasing into the part equivalent to said drum section in the case of extrusion molding of parison By setting up the rigidity of said opening neck more highly than the rigidity of said drum section, and moreover extruding in the cross-section configuration where two or more projections were arranged to the hoop direction in the outside layer of high rigidity resin, in the case of extrusion molding of parison The multilayer thin walled vessel characterized by preparing two or more ribs of high rigidity resin in said drum section along with an axis.
[Claim 2] The multilayer thin walled vessel according to claim 1 to which the rigidity of said pars basilaris ossis occipitalis is set more highly than the rigidity of said drum section by facing and increasing the quantity of the amount of extrusion of the high rigidity resin to the part equivalent to a pars basilaris ossis occipitalis into the part equivalent to a drum section in the case of extrusion molding of parison.
[Claim 3] The multilayer thin walled vessel according to claim 1 or 2 whose thickness of a drum section is 0.5-2.0mm.
[Claim 4] A multilayer thin walled vessel given in any of claims 1-3 whose thickness of the outside layer of the high rigidity resin in a drum section the thickness of the outside layer of the high rigidity resin in the opening neck is 50 - 95% of total thickness, and is 5 - 50% of total thickness they are.
[Claim 5] high rigidity resin -- MFRs 0.02-1.0 -- and the polyethylene of consistencies 0.940-0.970 or MFRs 0.2-4.0 -- and the low density polyethylene of consistencies 0.925-0.940 or a line -- a multilayer thin walled vessel given in any of claims 1-4 which are low density polyethylene and are polyethylene resin with which low rigidity resin contains the polyethylene of the consistencies 0.860-0.910 obtained with the metallocene catalyst, or the polyethylene concerned 50% of the weight or more they are.
[Claim 6] A multilayer thin walled vessel given in any of claims 1-4 which high rigidity resin is polypropylene of consistencies 0.885-0.930, and are polyethylene resin with which low rigidity resin contains the polyethylene or the polyethylene concerned of the consistencies 0.860-0.910 obtained with the metallocene catalyst 50% of the weight or more they are.
[Claim 7] A multilayer thin walled vessel given in any of claims 1-6 in which the gas barrier layer which consists of gas barrier nature resin is prepared they are.
[Claim 8] The multilayer thin walled vessel according to claim 7 whose gas barrier nature resin is an ethylene-vinylalcohol copolymer, a polyamide, or polyethylenenaphthalate.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About a multilayer thin walled vessel, this invention is the new container with which blow molding of the rigid high opening neck for cap wearing was carried out to the flexible drum section in detail at one, and relates to the suitable multilayer thin walled vessel for an infusion solution container, a food container, a drink container, etc.
[0002]
[Description of the Prior Art] For example, it replaces with the so-called infusion solution bag of the former processed into saccate [flat] with the film as an infusion solution container of medical application, and the thin walled vessel to which blow molding of the body of a container was carried out with comparatively flexible resin is proposed variously. On the whole, this thin walled vessel is equipped with a certain amount of rigidity, and since it is three-dimensional, while the high effluent nature and reduction nature like an infusion solution bag do not have, they are very easy handling. Moreover, it is necessary to equip with a plug, and in case the opening neck material for stiffening is welded like another line like an infusion solution bag or blow molding of the body of a container is carried out after producing the body of a container, the opening neck of the above-mentioned thin walled vessel inserts opening neck material, and is usually constituted by the infusion solution container.
[0003]
[Problem(s) to be Solved by the Invention] By the way, in order that the conventional thin walled vessel may use the opening neck material produced separately, a manufacturing installation and a production process become complicated. Moreover, there is also a problem referred to as being easy to generate a pinhole in the mounting area of opening neck material. It has the effluent nature and reduction nature which the purpose of is the thin walled vessel of the multilayer structure equipped with a drum section and the opening neck for cap wearing, and were more excellent by making this invention in view of this actual condition, and a pinhole can be prevented certainly, and it is in offering the new multilayer thin walled vessel which can be manufactured at a moreover still easier process.
[0004]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the multilayer thin walled vessel of this invention It is the thin walled vessel of the multilayer structure which was equipped with a drum section and the opening neck for cap wearing, and was really fabricated by the extrusion blow molding of parison. The outside layer and elastic modulus of high rigidity resin whose elastic modulus is 1500-18000kg/cm2 contain the inside layer of low rigidity resin 1000kg/cm2 or less. The amount of extrusion of the high rigidity resin to the part equivalent to said opening neck and by facing and increasing into the part equivalent to said drum section in the case of extrusion molding of parison By setting up the rigidity of said opening neck more highly than the rigidity of said drum section, and moreover extruding in the cross-section configuration where two or more projections were arranged to the hoop direction in the outside layer of high rigidity resin, in the case of extrusion molding of parison It is characterized by preparing two or more ribs of high rigidity resin in said drum section along with an axis.
[0005] In the above-mentioned multilayer thin walled vessel, the structure where the rigidity of the opening neck was set up more highly than the rigidity of a drum section maintains the flexibility of a drum section, and enables wearing of the cap to the opening neck. Moreover, since the firmness of parison extruded by

the specific cross-section configuration of the parison itself improves according to the rib structure constituted by the projection of the outside layer of high rigidity resin, it can raise the moldability at the time of being blow molding. And when the rib of the high rigidity resin prepared in the drum section after blow molding holds packing-ed, it can give rigidity required for a drum section. Therefore, thickness of parts other than the rib of a drum section can be made much more thin, and effluent nature and reduction nature can be raised further.

[0006]

[Embodiment of the Invention] The multilayer thin walled vessel of this invention is explained based on a drawing. drawing 1 shows the structure of the multilayer thin walled vessel concerning this invention -- they are the side elevation of fracture, and the horizontal sectional view of a drum section a part. Drawing 2 is drawing of longitudinal section showing the extrusion-molding machine of the parison used for the extrusion blow molding of a multilayer thin walled vessel. Drawing 3 is drawing of longitudinal section showing the extrusion-molding machine of the parison in drawing 2 from the side-face side of a direction different 90 degrees. Drawing 4 is the horizontal sectional view showing the cross-section configuration of the two-layer die in the extrusion-molding machine of parison. Drawing 5 is the horizontal sectional view of the parison by which extrusion molding is carried out with the two-layer die of drawing 4 . Drawing 6 is the horizontal sectional view of the parison by which extrusion molding is carried out with the two-layer die of other configurations. drawing 7 shows other examples of the lamination of a multilayer thin walled vessel -- it is the side elevation of fracture a part.

[0007] The multilayer thin walled vessel of this invention is a thin walled vessel of the multilayer structure which was equipped with a drum section (2) and the opening neck for cap wearing (3), and was really fabricated by the extrusion blow molding of parison, as a sign (1) shows to drawing 1 . As lamination of a multilayer thin walled vessel (1), although proper lamination, such as 2-5 etc. layers, can be adopted, a multilayer thin walled vessel (1) contains the outside layer (A) of high rigidity resin, and the inside layer (B) of low rigidity resin at least so that it may illustrate to drawing 1 . An outside layer (A) is a layer for giving required rigidity, and is constituted by the resin whose elastic modulus is 1500-18000kg/cm2. Moreover, an inside layer (B) is a layer for giving effluent nature and reduction nature, and an elastic modulus is constituted by resin 1000kg/cm2 or less and the resin whose elastic modulus is generally 100-1000kg/cm2.

[0008] the resin obtained in this invention, using a Phillips catalyst or a multistage Ziegler catalyst as high rigidity resin which constitutes an outside layer (A) -- it is -- MFR (melt flow rate) -- 0.02-1.0 -- and a consistency -- the polyethylene of 0.940-0.970, or MFR -- 0.2-4.0 -- and a consistency -- the low density polyethylene of 0.925-0.940, or a line -- low density polyethylene is mentioned. Moreover, as high rigidity resin, a consistency can also use the polypropylene of 0.860-0.930. In this case, 5% or more of block copolymer has a desirable rubber component.

[0009] On the other hand, as low rigidity resin which constitutes an inside layer (B), it is resin obtained by the gaseous-phase method, liquid phase process, or solution method which used the metallocene catalyst (single site catalyst), and the polyethylene resin with which a consistency contains the polyethylene (suitably henceforth "metallocene resin") of 0.860-0.910 or the polyethylene (metallocene resin) concerned 50% of the weight or more is mentioned.

[0010] The above-mentioned low rigidity resin is a very homogeneous polymer which has very sharp molecular weight distribution (for example, Mw/Mn=2-3.5) and very sharp presentation distribution, is excellent in flexibility and chemical resistance, and, moreover, has the property that the joining force with the gas barrier nature resin mentioned later is high. Moreover, when the polyethylene with which metallocene resin was mixed 50% of the weight or more, and usual low density polyethylene was mixed at 50 or less % of the weight of a rate is used, a moldability can be improved further.

[0011] As combination of the above-mentioned high rigidity resin which constitutes an outside layer (A), and the low rigidity resin which constitutes an inside layer (B), although various combination is mentioned From a viewpoint called thermal resistance in heat sterilization, especially the high rigidity resin of the outside layer (A) in a desirable mode It is polypropylene of consistencies 0.860-0.930, and the low rigidity resin of an inside layer (B) is polyethylene resin which contains the polyethylene or the polyethylene (metallocene resin) concerned of the consistencies 0.860-0.910 obtained with the metallocene catalyst 50%

of the weight or more.

[0012] When the multilayer thin walled vessel (1) of this invention faces and increases the quantity of the amount of extrusion of the high rigidity resin to the part equivalent to the opening neck (3) into the part equivalent to a drum section (2) in the case of extrusion molding of parison, the rigidity of the opening neck (3) is set up more highly than the rigidity of a drum section (2). consequently, sufficient rigidity for the opening neck (3) to equip with a cap (illustration abbreviation) -- demonstrating -- a drum section (2) -- after discharging packing -- abbreviation -- only the flexibility crushed completely is demonstrated. In addition, as a cap, the lid of screwing structure besides the lid of the shape of the shape of a seal and a plug etc. can be applied.

[0013] The configuration of the opening neck (3) is made into the proper configuration according to the gestalt of a cap. For example, it is fabricated by tubed [which the flange jutted out over upper limit] as shown in drawing 1 (a). Or it is fabricated by tubed [which has male **** / straight] although not illustrated. The thickness of the opening neck (3) of a multilayer thin walled vessel (1) is usually set as about 1.5-4.0mm, and it is constituted the 50 to 95 thick% by the outside layer (A) which consists of high rigidity resin.

[0014] The horizontal section configuration of a drum section (2) can be designed in the proper configuration according to applications, such as circular, an ellipse form, a flat abbreviation ellipse form, and an abbreviation rectangle. Except for the opening neck (3), 2.0mm or less, the thickness (thickness of the part except the below-mentioned rib (21)) of the drum section (2) containing a shoulder (4) and a pars basilaris ossis occipitalis (5) is usually set as about 0.5-1.5mm, and is constituted the 5 to 50 thick% by the outside layer (A) which consists of high rigidity resin.

[0015] Moreover, in the multilayer thin walled vessel (1) of this invention, the rigidity of a pars basilaris ossis occipitalis (5) may be set up more highly than the rigidity of a drum section (2) by facing and increasing the quantity of the amount of extrusion of the high rigidity resin to the part equivalent to a pars basilaris ossis occipitalis (5) into the part equivalent to a drum section (2) in the case of extrusion molding of parison. That is, the stability stability of a container and independence nature are securable by setting up the rigidity of a pars basilaris ossis occipitalis (5) more highly than the rigidity of a drum section (2).

[0016] Furthermore, in the multilayer thin walled vessel (1) of this invention, two or more ribs (21) of high rigidity resin as shown in drawing 1 are prepared in a drum section (2) along with an axis by extruding in the cross-section configuration (seeing the cross-section configuration of the parison of drawing 5) where two or more projections (21p) were arranged to the hoop direction in the outside layer of high rigidity resin in the case of extrusion molding of parison. Consequently, with a rib (21), rigidity required for a drum section (2) can be given, and thickness of parts other than the rib (21) of a drum section (2) can be made much more thin. And the firmness of the parison as an intermediate product itself can be improved, and the moldability at the time of blow molding can be raised further.

[0017] The rib (21) prepared in a drum section (2) by final blow molding is formed as a rib of cross-section configurations, such as an abbreviation hemicycle and an abbreviation triangle. Usually, the height of a rib (21) is made into about 5 - 50% of the total thickness of a drum section (2), and the number of ribs (21) is made about into 2-8. In addition, the configuration and protrusion height of a rib (21) are usually set up by the resin passage formed in the core (62) in a two-layer die, a below-mentioned interior ring (63), and a below-mentioned extrusion ring (64).

[0018] After the multilayer thin walled vessel (1) of this invention uses the extrusion-molding machine (6) shown in drawing 2 and drawing 3 and carries out extrusion molding of the parison (P) of the two-layer structure of an outside layer (A) and an inside layer (B), within the blow metal mold (illustration abbreviation) of the blow molding machine (9) which follows an extrusion-molding machine (6), it carries out blow molding of the parison (P), and is manufactured. As the extrusion-molding machine (6) for fabricating parison (P) is shown in drawing 2 and drawing 3 , it is constituted as a two-layer die and the 1st extruder (7) which supplies high rigidity resin, and the 2nd extruder (8) which supplies low rigidity resin are connected with this extrusion-molding machine (6).

[0019] As the 1st extruder (7) and 2nd extruder (8), although an accumulator-type extruder can also be used, the extruder of a screw in-line type which is illustrated is used, for example. The 2nd extruder (8) is equipped with the structure where the interior of the screw (84) which extrudes resin was carried out to the

screw cylinder (85) as shown in drawing 3 . It is constituted like [the 1st extruder (7) shown in drawing 2] abbreviation. And the 1st extruder (7) and 2nd extruder (8) are locally constituted possible [increase and decrease] in the amount of extrusion of resin by carrying out inverter control of the engine speed of a screw by the parison thick controller (illustration abbreviation).

[0020] Die head (61a) - which constitutes sheathing of equipment as an extrusion-molding machine (6) is shown in drawing 2 and drawing 3 (61c), The interior ring inserted between the core (62) inserted in the core of these die heads, and a die head (61a, 61b--) and a core (62) (63), It mainly consists of die bushings (66) of the extrusion ring (64) which is the lower limit periphery side of an interior ring (63), and was inserted in the lower limit side of a die head (61c) and a tip side extrusion ring (64b), and a tip side extrusion ring (64b) which follow a lower limit further.

[0021] A core (62) is constituted by some tip blocks which are located at the core of the fixed mandrel by which air passage (67c) was established in the axis, the movable mandrel which specifies the resin passage by the side of a periphery, and which can be adjusted and a tip side extrusion ring (64b), or a die bushing (66), and specify resin passage. Moreover, the tip of an interior ring (63) is equipped with the peripheral face of the taper whose diameter was reduced gradually as it goes to a lower limit, and a part is inserted in it to the inner circumference section of the taper of this inclination of an extrusion ring (64).

[0022] Between a die head (61b, 61c) and an extrusion ring (64), and an interior ring (63) The resin passage (67a) for extruding the high rigidity resin supplied from the 1st extruder (7) is formed, and the resin passage (67b) for extruding the low rigidity resin supplied from the 2nd extruder (8) is formed between the movable mandrel of a core (62), and an interior ring (63). And resin passage (67a) and resin passage (67b) are constituted so that it may join by the lower limit side of an extrusion ring (64).

[0023] The resin with which the rigidity extruded through each above-mentioned resin passage (67a, 67b) differs The resin which was unified in the condition of constituting a layer in an extrusion ring (64), and was unified It extrudes from the lower limit of a die bushing (66) to a blow molding machine (9) side through the gap formed of the tip block of a core (63), the tip side extrusion ring (64b), and the die bushing (66). And through the air passage (67c) of a core (62), when air or inactive supply SU, the parison (P) of two-layer structure is formed in the blow metal mold of a blow molding machine (9).

[0024] By the way, in the extrusion-molding machine (6), in order to obtain parison (P) as shown in drawing 5 , specific die structure is adopted. That is, as shown in drawing 4 , the notch is prepared in the hoop direction at constant pitch, and the resin passage (67a) formed between the extrusion ring (64) and the interior ring (63) equips the periphery of an interior ring (63) with the configuration to which the inner circumference side was widened in the fixed pitch. Thereby, the quantity of the high rigidity resin extruded through resin passage (67a) is increased partially, and eight projections (21p) are formed in the inner circumference side of an outside layer (A) in the cross section of the parison (P) extruded through a die bushing (66).

[0025] In extrusion molding of the above parisons (P), the thickness of an outside layer (A) and an inside layer (B) is set as specific thickness by adjustment of the flow rate of the resin by the parison thick controller, especially the flow rate of high rigidity resin. That is, the quantity of the amount of extrusion of the high rigidity resin to the part which faces and increases the quantity of the amount of extrusion of the high rigidity resin to the part equivalent to a pars basilaris ossis occipitalis (5) into the part equivalent to a drum section (2), and is equivalent to the opening neck (3) is faced and increased into the part equivalent to a drum section (2) by carrying out inverter control of the engine speed of the screw of the 1st extruder (62) by the parison thick controller.

[0026] Consequently, the part which carries out considerable [of the parison (P) extruded in blow metal mold / each] at a pars basilaris ossis occipitalis (5) and the opening neck (3) is formed heavy-gage. Moreover, since the obtained parison (P) is equipped with the outer layer (A) which consists of high rigidity resin, its whole melting tension is high and it demonstrates the shape retention ability which was excellent to the self-weight. And to the parison (P) extruded through the specific above-mentioned die structure, since the rib structure of high rigidity resin is beforehand constituted by the outside layer (A), parison (P) demonstrates the firmness which was further excellent with said rib structure. And an above-mentioned multilayer thin walled vessel (1) can be obtained by carrying out blow molding of the parison (P) extruded by blow metal mold as mentioned above with a conventional method. Moreover, since parison

(P) demonstrates the firmness which was excellent as mentioned above, the moldability in the case of blow molding can be raised further.

[0027] In the multilayer thin walled vessel (1) manufactured as mentioned above, the structure where the rigidity of the opening neck (3) was set up more highly than the rigidity of a drum section (2) maintains the flexibility of a drum section (2), and enables wearing of the cap to the opening neck (3). That is, since [that the thickness of the opening neck (3) is thick and] rigidity is high, the multilayer thin walled vessel (1) of this invention can equip with a cap easily and certainly to the opening neck (3). Moreover, when thickness of a pars basilaris ossis occipitalis (5) is thickened and rigidity is set up highly, the stability stability of a container and independence nature can be raised.

[0028] Furthermore, when the rib (21) of the high rigidity resin prepared in the drum section (2) holds packing-ed, it can give rigidity required for a drum section (2). Therefore, the multilayer thin walled vessel (1) of this invention can make thickness of parts other than the rib (21) of a drum section (2) much more thin, and can raise effluent nature and reduction nature further. And since the multilayer thin walled vessel (1) of this invention can really fabricate the whole by a series of above parison extrusion blow molding, it is very easy a production process, and moreover, since it does not need to weld another members, such as opening neck material, it can prevent generating of a pinhole certainly.

[0029] moreover, the multilayer thin walled vessel (1) of this invention is shown in drawing 6 in the case of extrusion molding of parison -- as -- the outside layer (A) of high rigidity resin -- setting -- two or more projections (21p) -- a hoop direction -- and two or more the same ribs as the above-mentioned mode can also be prepared in a drum section along with an axis by extruding in the cross-section configuration arranged the periphery side. The projection (21p) of the parison (P) shown in drawing 6 It can form by forming a slot in each inner skin of the extrusion ring (64) tip side extrusion ring (64b) in an extrusion-molding machine (6), and a die bushing (66). Consequently, like the above-mentioned mode, rigidity required for a drum section (2) can be given, and thickness of parts other than the rib of a drum section (2) can be made much more thin. And the firmness of the parison itself can be improved and the moldability at the time of blow molding can be raised.

[0030] Moreover, in the multilayer thin walled vessel (1) of this invention, the gas barrier layer which consists of gas barrier nature resin may be prepared. As gas barrier nature resin, an ethylene-vinylalcohol copolymer, a polyamide, or polyethylenenaphthalate can be used. As concrete layer structure, as shown in drawing 7 (a), the three-tiered structure which consisted of an outside layer (A) which consists of high rigidity resin, an inside layer (C) which consists of low rigidity resin, and a gas barrier layer (H) as an innermost layer is mentioned. In the multilayer thin walled vessel (1) of the three-tiered structure shown in drawing 7 (a), since transparency of oxygen can be prevented by the gas barrier layer (H), it can save, without deteriorating held packing-ed.

[0031] Moreover, as other layer structures, as shown in drawing 7 (b), 4 layer structures which consisted of the 2nd inside layer (B-2) as the outside layer (A) which consists of high rigidity resin, and an innermost layer which consists of the 1st inside layer (B) which consists of low rigidity resin, a gas barrier layer (H), and low rigidity resin are mentioned. Furthermore, as shown in drawing 7 (c), 5 layer structures which consisted of the outside layer (A) which consists of high rigidity resin, the 1st inside layer (B) which consists of low rigidity resin and a gas barrier layer (H), the 2nd inside layer (B-2) which consists of low rigidity resin, and an innermost layer (G) which consists of other resin are mentioned. In the multilayer thin walled vessel (1) of these four layers or 5 layer structures, the joining force with a gas barrier layer (H) can be heightened by using the polyethylene obtained with a metallocene catalyst as the 1st inside layer (B) and 2nd inside layer (B-2).

[0032] Furthermore, in the multilayer thin walled vessel (1) of this invention of each mode shown in drawing 1 and drawing 7 , since it excels in chemical resistance extremely when the inside layer (B) consists of polyethylene obtained with a metallocene catalyst, held packing-ed can safely and certainly be saved. Therefore, the multilayer thin walled vessel (1) of this invention can be used suitable for the infusion solution container of medical application, a food container, a drink container, etc.

[0033]

[Effect of the Invention] According to the multilayer thin walled vessel of this invention, since [that the thickness of the opening neck is thick and] rigidity is high, the appearance explained above can be

equipped with a cap easily and certainly. Moreover, since the multilayer thin walled vessel of this invention demonstrates the firmness excellent in the parison extruded by the specific cross-section configuration, it can raise the moldability at the time of blow molding. Furthermore, since the rigidity which needs for a drum section the rib of the high rigidity resin prepared in the drum section is given, thickness of a drum section can be made much more thin, and effluent nature and reduction nature can be raised further.
[0034] And since the multilayer thin walled vessel of this invention can really fabricate the whole by parison extrusion blow molding, it is very easy a production process, and moreover, since it does not need to weld another members, such as opening neck material, it can prevent generating of a pinhole certainly. Moreover, when the inside layer is constituted by the polyethylene obtained with the metallocene catalyst, chemical resistance can be raised further and packing-ed held can safely and certainly be saved.

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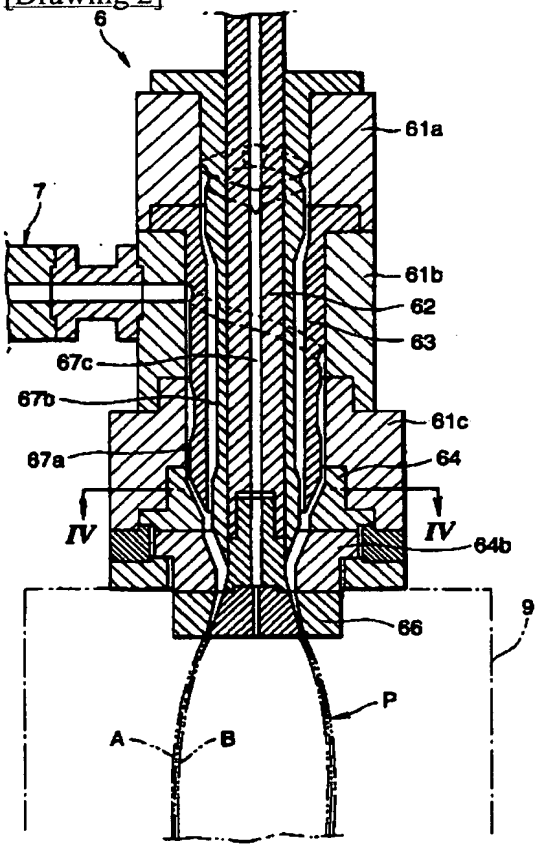
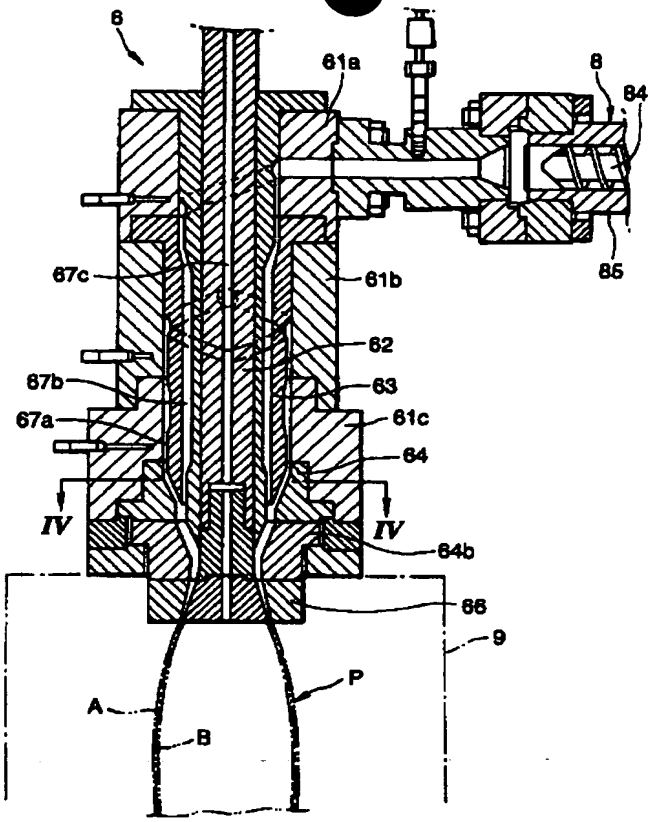
DRAWINGS

[Drawing 2]

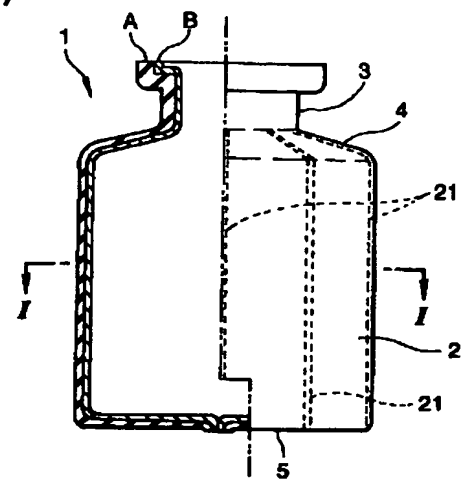


[Drawing 3]



[Drawing 1]

(a)



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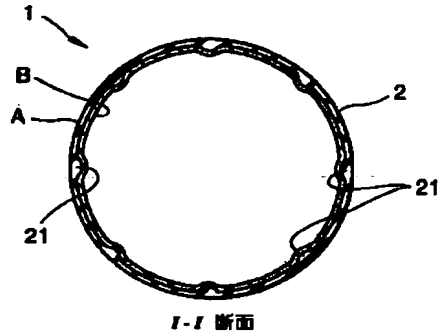
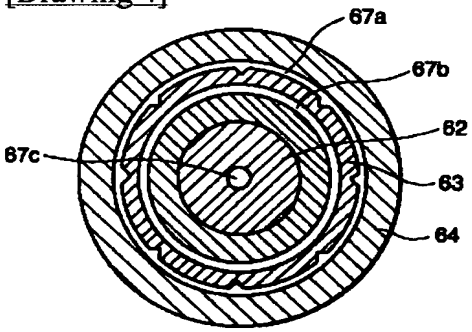


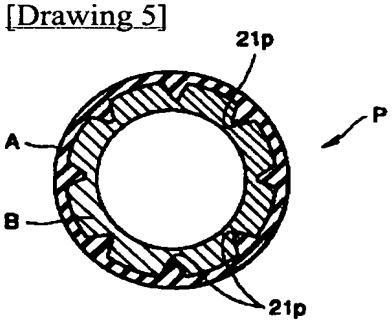
I-I 断面

[Drawing 4]

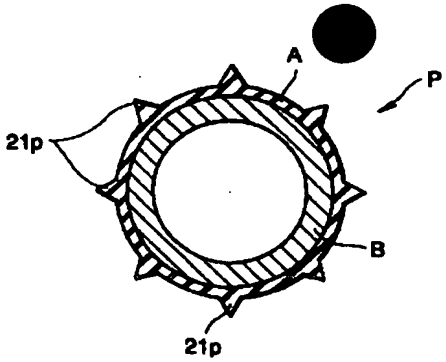


IV-IV 断面

[Drawing 5]

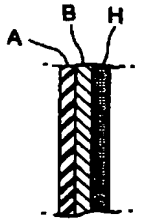


[Drawing 6]

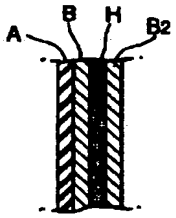


[Drawing 7]

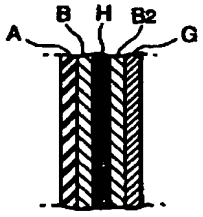
(a)



(b)



(c)



[Translation done.]